Preliminary Methods for Volume Determinations

December 14, 2010

Presentation Overview

- Objective: Inform EPA of methods proposed to determine volumes of sediment for alternatives screening
- Key Conclusions:
  - Existing core data can be readily used to determine volumes for alternatives screening using any defined chemical concentration (e.g., screening levels, cleanup levels, etc.)
  - Demolition/reconstruction of structures is cost prohibitive and can be “pre-screened” from further consideration
    - Therefore, volumes for full removal under structures do not need to be defined
  - Engineering factors can be considered and added to provide a reasonable estimate of volumes suitable for an FS-level determination
- All analyses are preliminary and subject to change in the alternatives screening

Purpose of Volume Determination

- For remedial alternatives that include dredging (and/or ex-situ treatment), volumes of sediment need to be determined
- Allows costs for dredging and disposal to be estimated for screening

Volume Determination Methods

- LWG is currently evaluating the uncertainty related to the Focused PRGs EPA has identified
- Consequently, specific screening levels or cleanup levels to apply in volume determinations cannot be defined at this time
  - "Screening values" may be applied in the alternatives screening
  - Refined "cleanup values" would be applied in the detailed analysis of alternatives
- Further, not all screening or cleanup level exceedances will be dredged. The LWG is currently evaluating dredge, cap, and MNR areas.
  - We present here methods (not results) that can be used in volume determination regardless of actual levels eventually selected
  - Actual volumes can be calculated once appropriate screening or cleanup levels are defined

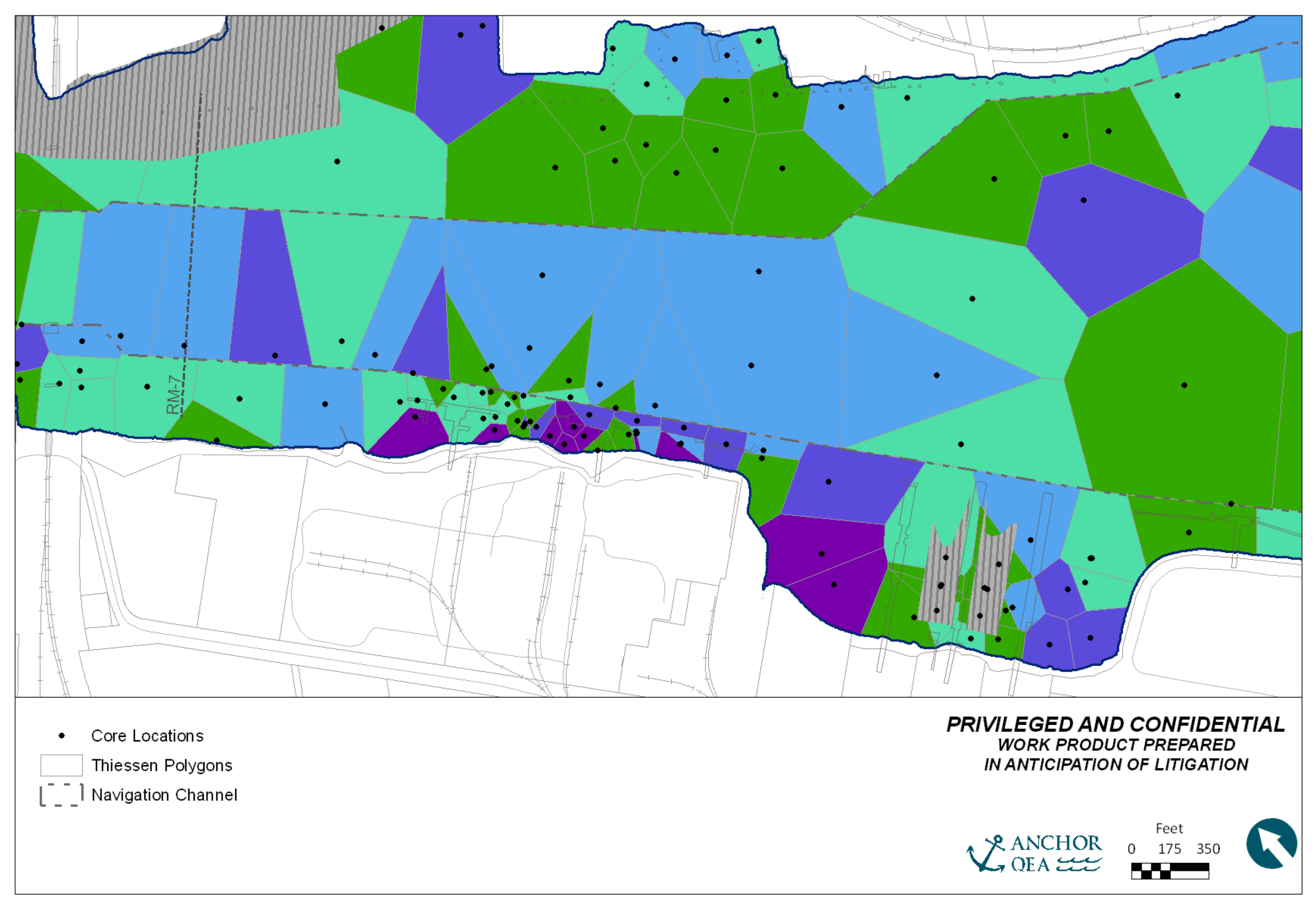
Depth of Impacts Steps

1. Divide the study area into Thiessen Polygons based on core locations
2. Assign “primary” chemicals to be evaluated in each core based on the surface sediment chemicals causing an SMA to be present
3. Initially screen “primary” chemicals in core intervals against screening levels or cleanup levels
4. Second phase screening of additional chemicals by comparison to surface sediment concentrations

1. Divide the Study Area into Thiessen Polygons

- Study area is divided into Thiessen polygons using all subsurface cores containing at least one chemical on a screening level list
- The navigational channel is used as a boundary condition to Thiessen polygons
  - Samples collected in the navigation channel apply to areas in the navigation channel only
  - Samples collected outside the channel apply to near shore areas only

1. Divide the Study Area into Thiessen Polygons



2. Assign “Primary” Chemicals to each SMA

- Chemicals are assigned to each SMA based on the screening or cleanup levels used to define SMAs in surface sediment:
  - These chemicals are referred to as “primary chemicals” for evaluating the depth of impact
  - Primary chemicals are assigned by Thiessen polygon instead of by core
- Other chemicals (non-primary chemicals for any given SMA) are evaluated in a later step

3. Initial Screen of “Primary” Chemicals in Core Intervals

- For each core, a preliminary depth of impact is determined based on the deepest core interval, where any primary chemical exceeds its screening or cleanup level
- Other methods for defining volumes not involving screening level-type values are also being explored
  - This may be needed to assess the screening level over its appropriate exposure area (e.g., river mile, site-wide, etc.)
  - Depending on future methods, an “exposure area factor” for use of the screening level may be applied to define depth of impact consistent with surface exposure assumptions

3. Initial Screen of “Primary” Chemicals in Core Intervals (cont.)

- Screening or cleanup levels are not applied to cores outside the exposure area of the level in question
- Some screening or cleanup levels have limited exposure areas; for example:
  - Clam consumption levels apply to water elevations where people could conceivably attempt to harvest
  - Human health in-water sediment direct contact levels apply to areas outside the navigation channel only
  - Human health beach sediment direct contact levels apply to beaches only
  - Eco. bird dietary sandpiper (worm) levels apply to sandpiper beaches only

3. Initial Screen of "Primary" Chemicals in Core Intervals (cont.)

- For benthic toxicity, propose to use an approach similar to a Mean Quotient (MQ)
- MQ or similar would be applied to an expanded list of chemicals at depth as necessary to calculate the quotient (or similar value)
- For example, using the LWG proposed benthic risk area approach, core intervals with an MQ > 0.7 would be included in the depth of impact
- This methodology is dependent on resolution of the benthic toxicity evaluation

4. Second Phase Screening of Chemicals in Core Intervals

- The preliminary depth of impact is adjusted by an analysis of the “non-primary” chemicals
- Evaluate sediments immediately below the initial screened depth
- Assess where there are “elevated” concentrations of “non-primary” chemicals immediately below the depth identified using primary chemicals
- Indicates a potential need to increase the preliminary depth of impact to account for non-primary chemicals

4. Second Phase Screening of Chemicals in Core Intervals

- "Elevated" concentrations are identified where the buried concentration of the non-primary chemicals is greater than the surface concentration at the same location
  - This condition would raise the SWAC for that chemical in the exposure area under a dredging scenario, potentially to levels that exceed the screening or cleanup level
  - Reasonably conservative assumption, but does not necessarily equate to risk being present if that interval were revealed
- Evaluating conservatism of this step further, may determine a more detailed approach
  - Initial evaluations indicate primary chemicals would likely identify the vast majority of potential volume

Volume Determinations - Constructability Considerations

- Site uses
- Presence of structures (docks, etc.)
- Site constraints
- Slope stability
- Over dredge allowance
- Navigation channel and channel approach requirements and constraints

Dredging Structure/Slope Evaluation

- Evaluated how to work around structures, which impacts volume estimates
- Conducted “pre-screen” evaluation of structure demolition, contaminated sediment removal, and reconstruction scenario
- For structures staying in place, defined rules for offsets and constrained operational conditions
- Developed rule for dredging in and around near shore slopes

"Pre-Screen" Structure Demolition/Reconstruction

- Pre-screening evaluation of costs for over-water structure demolition and replacement
- Considered typical scenarios where remedial actions are necessary within structure footprint
- Estimated costs for demolition and replacement of typical structures
- Compared to screening costs of working around structures
- Compare costs to alternative, less intrusive remedies (e.g., capping and MNR)
- All costs preliminary and for screening purposes only

Typical "Heavy" Structure

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Typical "Light" Structures

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Structural Demolition/Construction Screening Costs

- Typical overwater demolition screening costs
  - Engineer's estimates \$40 to \$45/ft^2
  - Pacific Northwest Bid Tabs \$13 to \$18/ft^2
    - Construction only – design would be extra
- Typical overwater construction screening costs
  - Engineer's estimates \$275 to \$350/ft^2
  - RS Means municipal wooden pier \$220/ft^2
    - Construction only – design would be extra
- Estimated dredging screening costs
  - Dredge & Disposal 5-foot deep = \$60 to \$75/ft^2
  - Dredge & Disposal 10-foot deep = \$120 to \$150/ft^2

Comparison Structure Demolition/ Construction to Capping

- Total typical dock demolition, dredging, construction screening costs overall range
  - \$300 to \$550/ft^2
- Typical capping under dock screening cost
  - \$15/ft^2
- Cost disproportionate

Structural Screening Cost Evaluation Conclusions

- Some structures can be removed and replaced cost-effectively (e.g., floating docks)
- In these areas, dredging is considered “unconstrained” and included in volumes determinations
- Where structures cannot be easily removed, the cost of overwater demolition and replacement is disproportionate to dredge and cap or cap only alternatives

Structural Screening Cost Evaluation Conclusions (cont…)

- The disproportionate cost conclusion also applies to dilapidated structures
  - Most owners will likely want to maintain established site uses for future needs
  - Possible that removal can be integrated with structural upgrades during remedial design, which could involve additional removal beneath existing structures
  - The locations and/or extents where this might occur cannot be predicted at the FS level

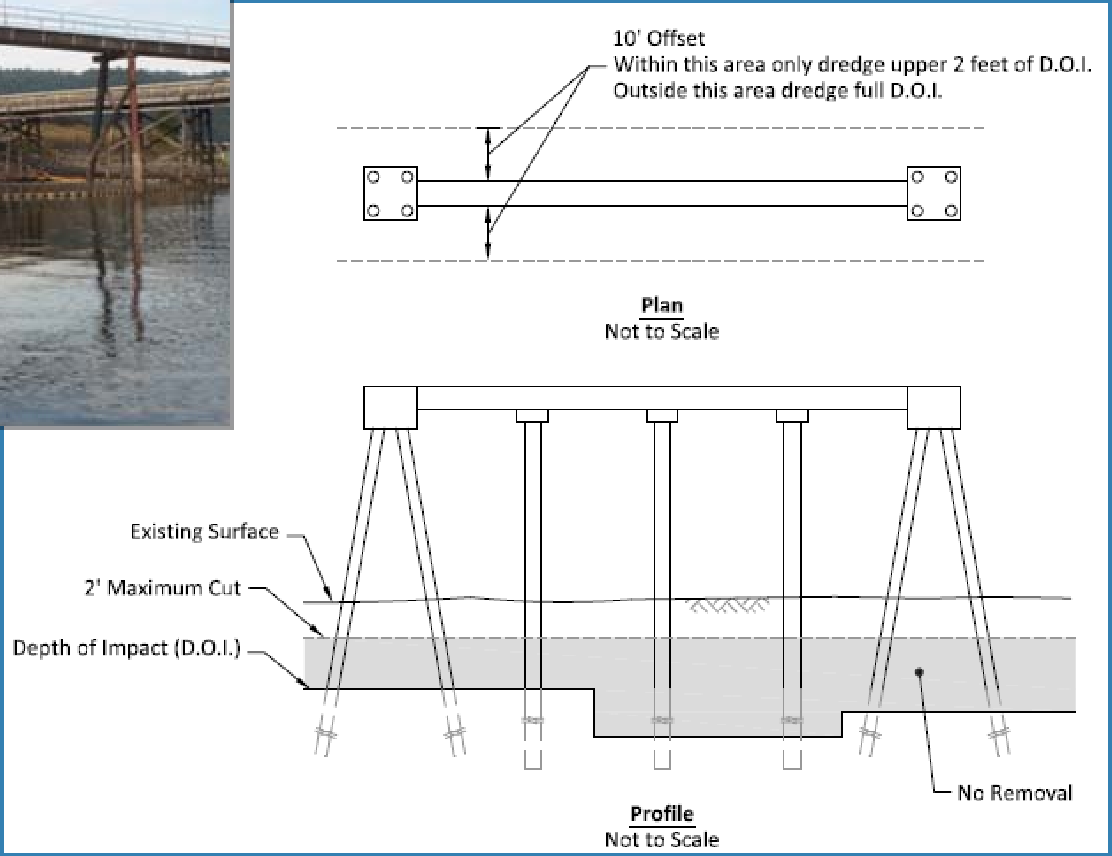
Structural Screening Cost Evaluation Conclusions (cont…)

- Therefore, rules are developed to evaluate appropriate actions and volumes where structures are present:
  - Dredge offsets from structures
  - Dredge and cap where offsets are used
  - Capping where there is no access for dredging
  - Constrained production rates (higher costs)

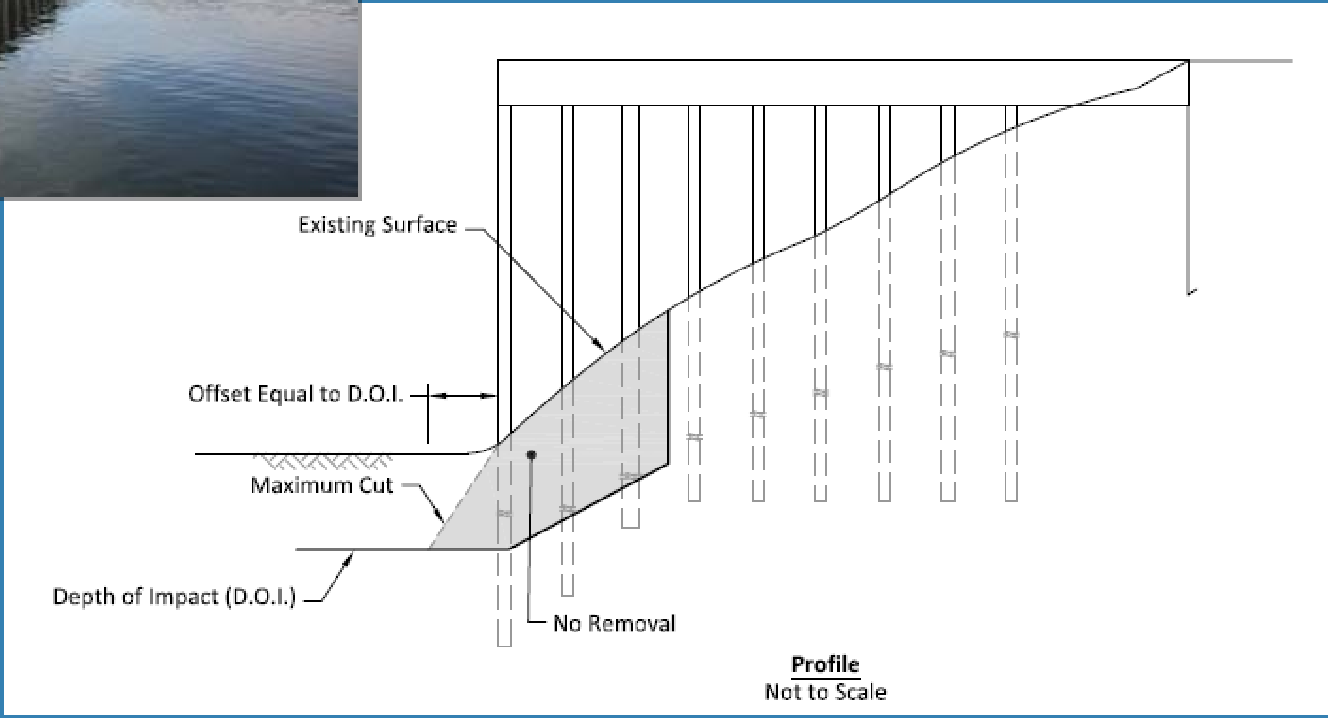
Volume Determination - Dredging Suitability and Design

- Different offset rules developed:
  - Dredging adjacent to catwalk
  - Dredging adjacent to waterfront pier
  - Dredging adjacent to bridge pier and marine launch way
- Slope dredging rule developed
- Structures where dredging access is constrained:
  - Access limited by catwalk and pier
  - Access limited by tight pile spacing or sheet pile wall

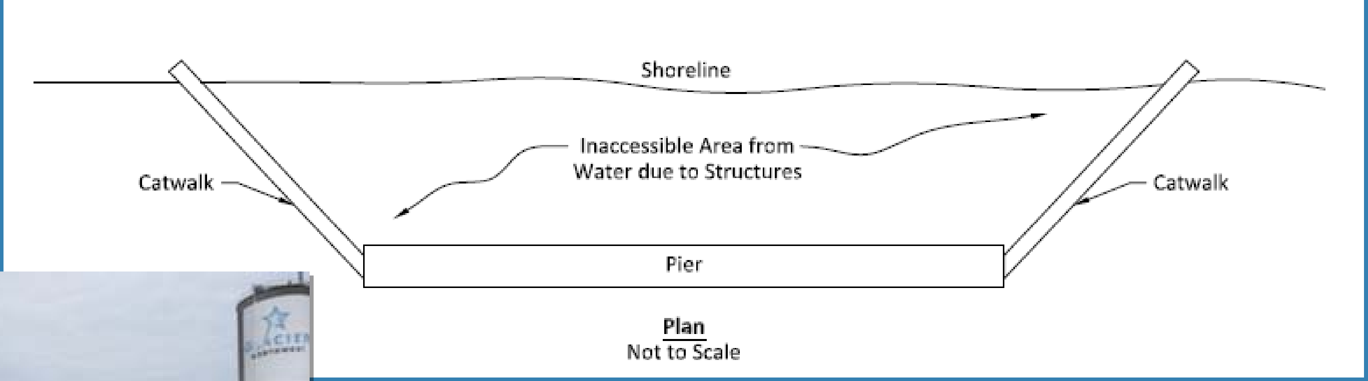
Dredging Around Catwalk



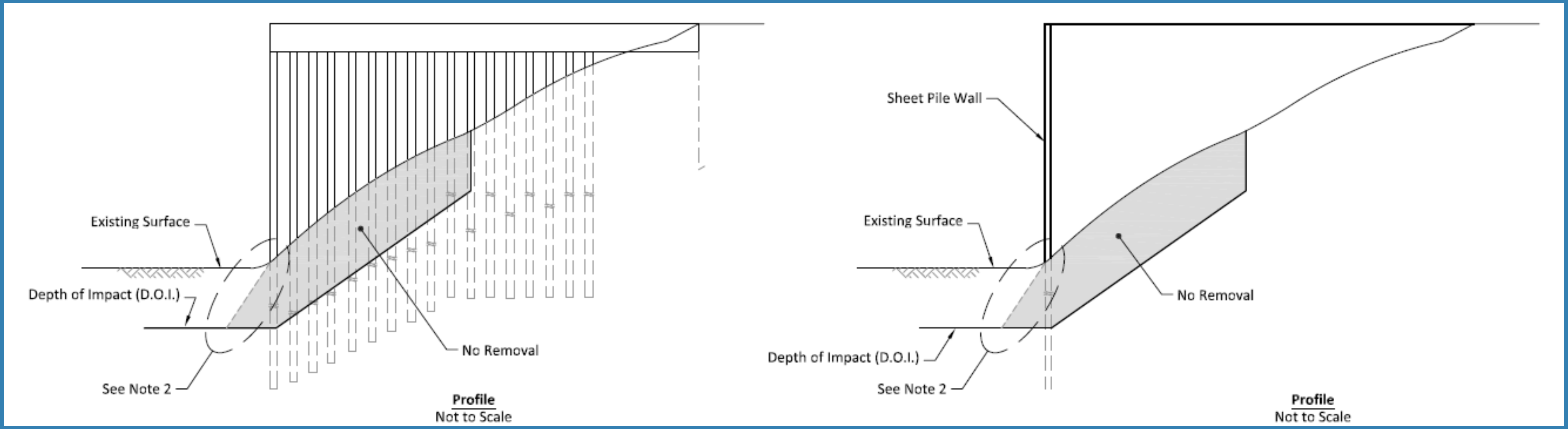
Dredging Adjacent to Pier



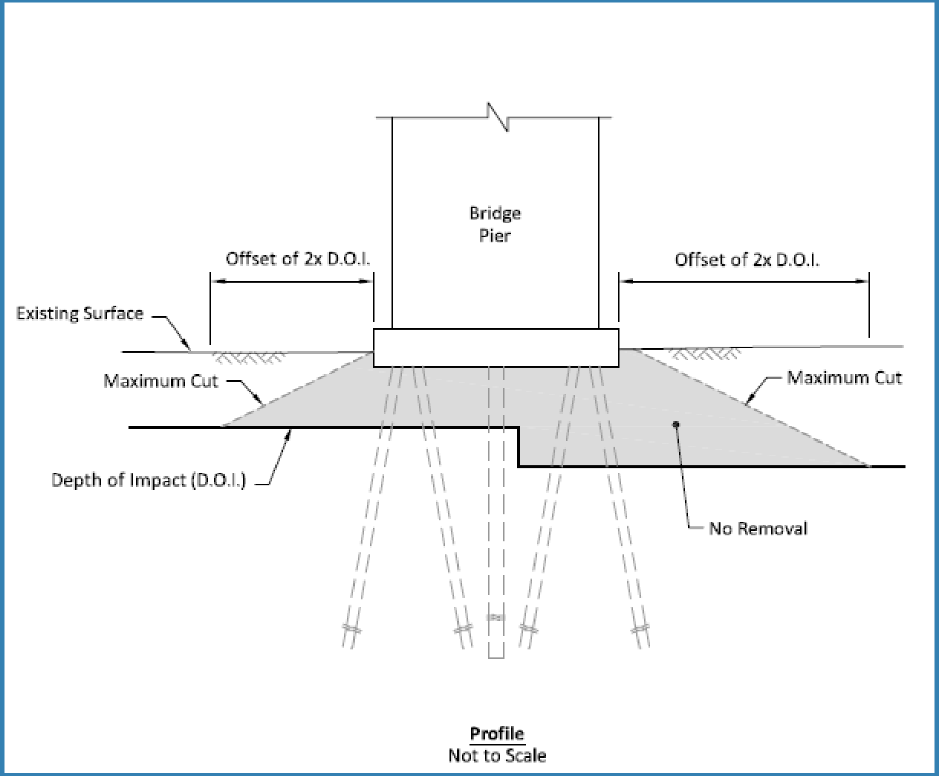
No Access – Pier and Catwalk



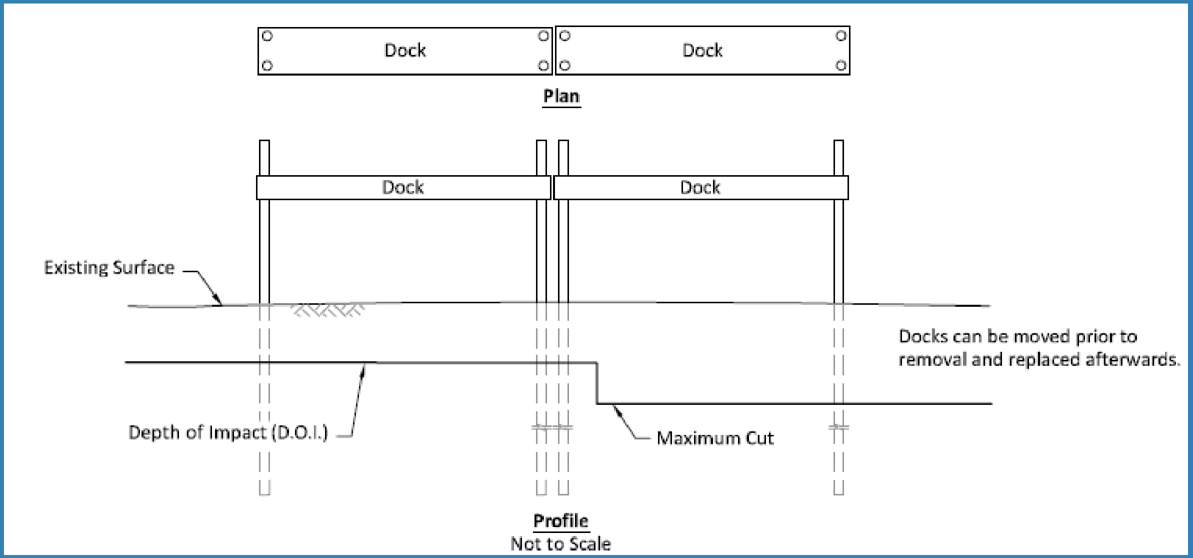
No Access – Tight Pile Spacing or Sheet Pile Wall



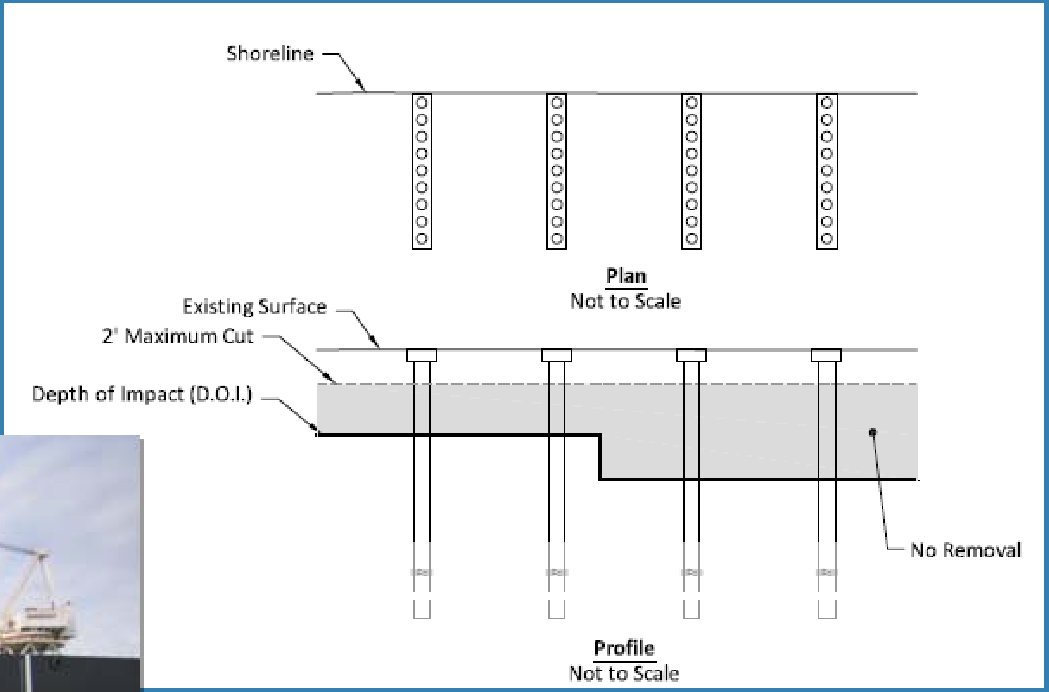
Dredging Adjacent to Bridge



Floating Dock That Can be Removed



Dredging Adjacent to Marine Launch ways



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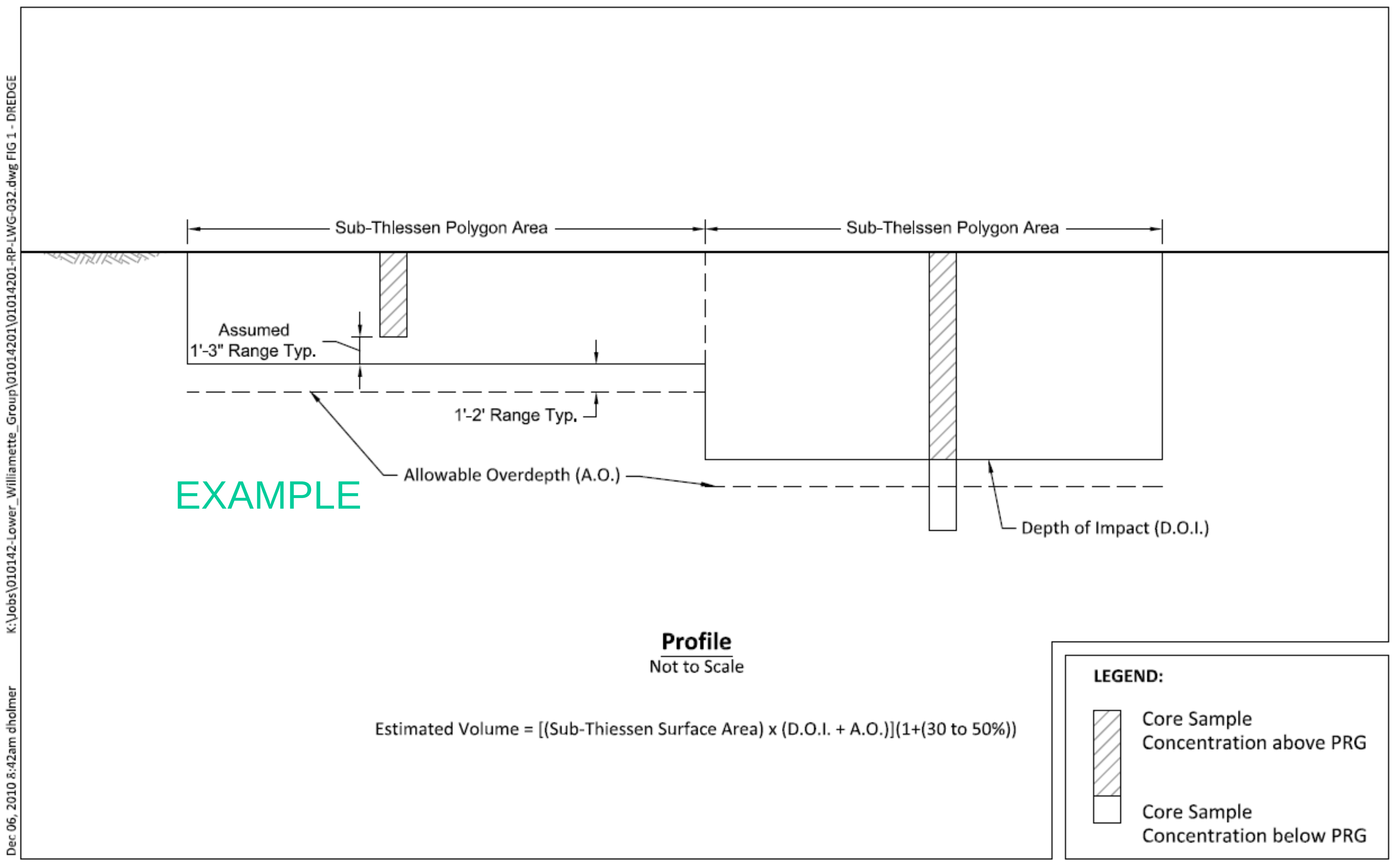
Dredge Volume Development

- Eventual SMAs will be evaluated for depth of impact (DOI) on a core-by-core basis
- Dredge volume = SMA Area x DOI
- Where the bottom of the core at the DOI is contaminated, assume additional depth
  - Range of 1 to 3 ft will be applied
- An over-dredge allowance of 1 to 2 ft will be applied

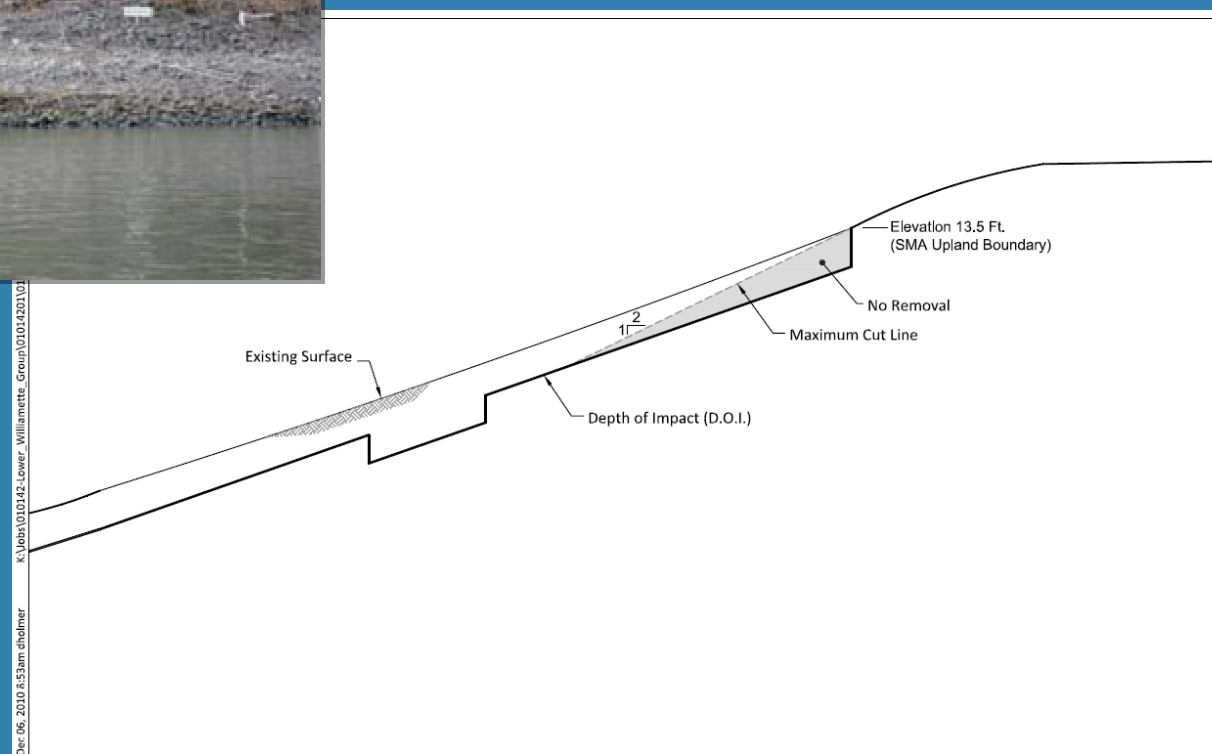
Dredge Volume Development (cont…)



Dredge Volume Development (cont…)

- A 30% to 50% factor will be added to the (neatline) + (over-dredge) volumes to account for "engineering design" factors
- As a conservative FS-level assumption, dredge cut slopes as steep as 2H:1V from top of bank to DOI will be included in the volumes so as to maximize the estimated removal volume
  - For many dredging projects, typical design side slopes are flatter (4H:1V), which would result in less material removed above the DOI

Slope Dredging



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Dredge Volume Development (cont.)

- Slope stability is evaluated using engineering judgment and experience considering site soil characteristics and typical stable dredge cut slope angles
  - Detailed evaluation of slope stability would typically be performed during remedial design
- Navigation channel dredge volumes are based on DOI only using existing core data
  - Additional clean material that might need maintenance dredging to achieve authorized channel depths would not be included in contaminated volume estimates

Dredge Volume Uncertainty

- In areas with potential dredge residual issues
  - Additional 1 ft cleanup pass is assumed everywhere
  - And/or placement of post-dredge clean sand cover as needed
- This approach consistent with current national direction, which is moving away from multiple “cleanup passes”
- Each additional pass has diminishing ability to improve surface concentrations and greatly impacts costs
  - Particularly problematic when attempting to remediate to very low concentrations
- Volumes (and costs) for dredging could greatly expand if EPA Region 10 requires a multi-pass approach to dredge residuals

Presentation Conclusions

- Existing core data can be readily used to determine volumes for alternatives screening using screening or cleanup levels once those are defined
- Demolition/reconstruction of structures is cost prohibitive and can be “pre-screened” from further consideration
  - Therefore, volumes for full removal under structures do not need to be defined
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